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The Effect of Debt Burden on Consumption of Household

부채 부담이 가계소비에 미치는 영향

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Abstract

The Effect of Debt Burden on Consumption of Household

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This paper analyzes whether household debt burden affects household consumption; and if so, whether its impact differed before and after the financial crisis of 2008. These questions are addressed by means of regression analyses that include debt burden as an independent variable, to examine the extent to which debt burden affects consumption. The models replace debt burden with debt-to-income ratio (DTI) or change in debt. To check the robustness of the regressions, alternative regressions with interaction terms, and with log variables are also examined. The results show that debt burden negatively affects household consumption, and such influence was especially pronounced in absolute value immediately after the 2008 financial crisis.

keywords : Household consumption, household debt, debt-to-income ratio, financial crisis
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1 Introduction

For the past few years, aggregate household debt has increased continuously and consumption growth has stagnated. Especially in Korea, household debt has become a huge economic problem. According to the data from the Bank of Korea, the aggregate amount of debt does not decrease, but rather increases at an alarming rate. It announced that total debt amounted to approximately 1300 trillion won by 2016, and total household debt shows rapid rate of increase, as shown in Figure (1). In particular, Figure (1) shows that the growth rate of household debt is over ten percent since 2015. This implies that many households in Korea suffer from this rapid increase in debt burden. On the other hand, Figure (2) presents real personal consumption expeditures (PCE) and its year-on-year growth rate in Korea. In Figure (2), household consumption shows sluggish increase, especially after the financial crisis of 2008. In short, debt overhang has coincided with sluggish growth in consumption. This is a considerable issue in the economy because it inhibits growth of the economy and perpetuates the effects of the recession. Consequently, recovery from the financial recession occurs at a slower pace, and economic indicators are less promising than before the crisis. Also, since the recession has led to decreases in asset values, leverage of household has increased.

Thus, it is important to conduct research on the factors contributing to these changes in consumption. When analyzing how household consumption responds to economic shocks, wealth and income are interpreted as major factors for consumption. In traditional models, wealth and income are the main variables that contribute to changes in consumption. Typically, if household wealth decreases, households may cut their spending while increasing saving. This wealth effect is one of the ways in which consumption responds to wealth shocks. Until recently, less attention has been paid to household debt, and so comparatively few studies have focused on how debt influences changes in consumption. Change in debt is often considered to be the result of change in consumption, rather than as an independent variable that exerts an influence on consumption.

However, recent studies suggest that this relationship may not be accurate. In other words, debt can be a driving variable that explains change in consumption. Debt burden can affect household consumption when considering deleveraging, as Eggertsson and Krugman (2011), Cooper (2012), and Dynan (2012) mentioned. If wealth declines due to recession, deleveraging would occur because households having a pessimistic view of the economy might seek to avoid debt overhang in highly uncertain circumstances. Furthermore, their ability to borrow would decrease along with the decrease in asset value. Consequently, deleveraging would occur, and this process would result in decline in household consumption.

This study provides empirical evidence for the extent to which consumption is affected by debt burden. In particular, it focuses on how this effect might differ before and after the financial crisis of 2008. This is because the crisis has caused significant changes in consumption, assets, and other economic variables over the past few years. Debt burden is included as an independent variable in the regression to explain the change in consumption. Wealth and income are added as independent variables, and other control variables, such as the age and education level of household head, are also included. Data from the Korea Labor and Income Panel Study (KLIPS) for 20072015 are used to compare the influence of debt burden on consumption before and after the financial crisis. The effects of debt burden are estimated over the entire period (20072015) and annually.

I further examine whether there is heterogeneous impact of debt burden on consumption across households depending on the amount of debt. Moreover, during housing market bubbles prior to the financial crisis, house prices appreciated rapidly, especially in the Seoul metropolitan area, and households living in that boom region were willing to borrow more to buy homes. Thus, they were more likely to hold debt burden exceeding their capacity to repay or the subsequent values of their homes. This phenomenon of declining asset (housing) values has resulted in households experiencing higher leverage following the financial recession. Thus, analyzing the effect of debt burden based on samples of different household types (those located in boom regions, and those in non-boom re-

gions) might help address the question of whether debt burden influences consumption differentially according to the level of household debt.

The rest of the paper is organized as follows. In section 2, I review previous studies that examine the factors contributing to change in consumption. In particular, I focus on the literature that utilizes debt as an independent variable explaining changes in consumption. Section 3 describes the data used to examine the research questions. Section 4 explains the regression models used to analyze the effects of debt burden on household consumption. The regression first uses debt-to-income ratio (DTI) as debt burden. The second part of the regression then uses change in debt, calculated using log difference, as debt burden. Section 4 checks the robustness of the estimated results by applying regression models that include interaction terms or log variables. Section 5 summarizes the estimated coefficients of debt burden from the models described in section 4, and analyzes the effect of debt burden. Finally, section 6 presents conclusions drawn from the research.

2 Previous literature

Few previous studies have focused on the role of debt in household consumption. When analyzing the sources of changes in consumption, most previous studies focus on wealth and income as factors that might explain changing consumption. For example, Baker (2015) examines whether household consumption with higher debt is more responsive to change in income. Even though that study uses a leverage variable in the regression, it only takes the form of an interaction term rather than an independent variable. That paper mainly focuses on the relationship between consumption and income.

On the other hand, several studies have investigated the role of debt when examining the sources

of changes in consumption. For instance, Eggertsson and Krugman (2012) argue that deleveraging can restrict household consumption, and that households attitudes toward leverage can be changed. Ludvigson (1999) studies the correlation between change in consumption and change in credit. It was concluded that growth in consumption can be predicted by consumer credit. Dynan (2012) suggests that household debt overhang may hold back household consumption. Thus, following the financial crisis of 2008, it would take a long time to regain the previous level of household consumption. However, that study only uses Panel Study of Income Dynamics (PSID) household data of waves 2005, 2007, and 2009, which correspond to data for 2004, 2006, and 2008, respectively. Therefore, it is difficult to analyze whether the effect of debt overhang persists after the financial crisis. Dynan and Edelberg (2013) report that highly leveraged households cut their spending more even after they control other variables affecting consumption. Regression models in that study include variables indicating whether a household was experiencing difficulty in refinancing a mortgage, and whether a household had been denied credit. Mian et al. (2012) first focus on the role of wealth in changes in consumption. Therefore, that study divides net wealth into housing wealth and financial wealth. They then examine the effects of changes in housing value on households marginal propensity to consume (MPC). Mian and Sufi (2011) show the link between household borrowing and home prices. They describe that house prices do not uniformly affect borrowing among the population.

Furthermore, even after analyzing the effects of household debt repayments on household consumption during and after the Great Recession, Cooper (2012) maintains that the relationship between consumption and income or wealth should continue. The study concludes that there is little evidence that deleveraging exerts an influence on consumption.

3 Data

The present study uses household survey data from the Korea Labor and Income Panel Study (KLIPS) to examine whether debt burden affects household consumption in Korea. The KLIPS survey was launched in 1998 and collects a wide range of information on households and household members. The most recent data are from 2015 (labeled as wave 18). The survey is conducted annually, thereby providing extensive annual panel data on households' wealth, consumption, savings, debt, as well as personal information on the age and educational level of each household member.

Since the present study focuses on the effect of debt burden on household consumption, and whether this differs significantly during and after the financial crisis, the KLIPS data sets are taken from wave 10 to wave 18, which correspond to years 20072015. The analysis employs variables on consumption, assets (including houses), income, total debt, monthly debt repayment, unemployment rate, head of household's age and education level. Using these variables, I analyze and consider the effect of debt burden on change in consumption throughout the entire period (20072015) and by individual year.

Based on the paper by Dynan (2012), rather than using log differences, I calculate the changes in consumption, wealth, and income using inverse hyperbolic sine, in order not to overlook variables with negative values. Therefore, the inverse hyperbolic sine is calculated for each variable before differencing, and is then multiplied by 100 to give the percent change. In terms of Debt burden variable, I use debt-to-income ratio and log difference of total debt (change in debt), which are lagged by one period. The debt variable is lagged in order to minimize the reverse causality problem following Carroll (1997) and Dynan (2012). This preceding level of debt is related to household consumption. In particular, I calculate debt-to-income ratio by first multiplying 12 to household's amount of debt to be paid each month to give annual household debt repayment (the numerator of DTI). And then, dividing this value by annual household income gives the households DTI ratio i.

Unemployment rate is calculated by dividing the number of unemployed households by total labor force during that period. I also use personal data: head of households age, and a college degree dummy variable (which is 1 if the household head holds a college degree).

4 Model

As I mentioned above, in traditional frameworks, debt does not act as an independent variable that influences consumption. This concept is reflected in equation (1), where ΔC_{it} is the change in consumption of household i in period t, ΔW_{it} is the change in its wealth or asset, ΔY_{it} is the change in its income.

$$\Delta C_{it} = \alpha + \beta_w \Delta W_{it} + \beta_y \Delta Y_{it} + \varepsilon_{it} \tag{1}$$

However, the models in the present study consider debt burden as a contributory factor for decisions on household consumption. Debt burden can be a leading variable in changing household consumption. The models presented here are based on those used by Dynan (2012) and Carroll (1997), which include debt as an independent variable in the regression, as shown in equation (2). The present study therefore aims to verify whether debt burden exerts an independent influence on consumption. The debt burden variable can be measured by debt-to-income ratio or change in debt ($\Delta Debt_{i,t-1}$). In the case of DTI, the numerator is the annual debt to repay (principal and interest) and the denominator is the annual income of the debtor. In other words, it is the ratio of annual income that goes towards debt repayment. Change in debt is the change in the total amount of debt that each household has; log difference is used when calculating the change in debt. The debt burden variable in the regression is lagged by one period. Thus, ex ante level of debt is related to the household

consumption in each t period. Both DTI and change in debt are measured at the beginning of the period over which the change is computed.

$$\Delta C_{it} = \alpha + \beta_w \Delta W_{it} + \beta_y \Delta Y_{it} + \beta_d (Debt\ burden)_{i,t-1} + \varepsilon_{it} \tag{2}$$

Equations (3) and (4) are regressions with additional control variables. For example, UR_{it} is the unemployment rate of period t, Age_{it} is age of household's head, and CD_{it} is the dummy variable for whether the household head has a college degree. Equation (4) also includes unemployment rate and income as independent variables following Dynan (2012).

$$\Delta C_{it} = \alpha + \beta_w \Delta W_{it} + \beta_y \Delta Y_{it} + \beta_d (Debt\ burden)_{i,t-1} + \beta_{ur} UR_{it} + \varepsilon_{it} \tag{3}$$

$$\Delta C_{it} = \alpha + \beta_w \Delta W_{it} + \beta_y \Delta Y_{it} + \beta_d (Debt\ burden)_{i,t-1} + \beta_{ur} UR_{it} + \beta_y Y_{it} + \beta_A Age_{it} + \beta_{cd} CD_{it} + \varepsilon_{it} \tag{4}$$

4.1 Baseline models

4.1.1 Models with debt-to-income ratio (DTI)

In this section, the debt burden variable is substituted by DTI in the regressions above. The debt value in DTI is calculated by multiplying a household's monthly debt repayments (principal and interest) by 12 to give annual household debt repayment. Dividing this value by annual household income gives the household is debt-to-income ratio. The debt burden variable relates to the value in the preceding period, so the model uses the DTI value in the previous period (t-1). The baseline model is based on the regression models used by Carroll and Dunn (1997), Bruno and Georgi (2015), and Dynan (2012), whose regressions include wealth, income, debt burden, and other control variables

as independent variables to explain changes in consumption. The equation (5) shows the baseline regression of this model.

$$\Delta C_{it} = \alpha + \beta_w \Delta W_{it} + \beta_y \Delta Y_{it} + \beta_{dti} DTI_{i,t-1} + \beta_{ur} UR_{it} + \beta_A Age_{it} + \beta_{cd} CD_{it} + \varepsilon_{it} \quad (5)$$

As explained previously, when calculating the changes in variables such as consumption, wealth, and income, an inverse hyperbolic sine is used (rather than using log differences). I therefore calculate the inverse hyperbolic sine of each variable before differencing. Also, other control variables, including unemployment rate, age of household head, and dummy variable for college degree are added to the regression.

Moreover, using baseline equation (5), alternative regressions are used to further examine the role of debt in consumption changes. First, alternative regression is conducted for different household samples. Subgroups of samples are: households living in regions that experienced rapid house price appreciation during the boom, and others living in non-boom regions with less pronounced house price appreciation. As shown in Figure (3), house prices in the Seoul metropolitan area (Seoul, Gyeonggi-do, Incheon) showed greater appreciation than in other regions. Since the housing bubble was much more pronounced in the Seoul metropolitan area, it was specified as a speculative zone. I therefore define boom regions as the Seoul metropolitan area, and non-boom regions as other areas in Korea. Based on this, I divide households into two groups and conduct regressions on each of the boom/non-boom sub-samples.

In addition, in the second alternative regression of equation (5), the debt burden variable is replaced with a dummy variable, indicating 1 if the household is in the top quintile ranked by DTI in that period. By doing so, we can assess whether households with higher debt burden experienced more debt overhang that held back household consumption over the years.

Lastly, since it is meaningful to know the extent to which debt burden influences household

consumption more than the wealth effect, regression without the wealth variable would suggest the pure effect of debt on consumption. Equation (5.1) shows an alternative regression of equation (5) in which the wealth variable is omitted. Through this, we can estimate the direct effect of debt burden on consumption.

$$\Delta C_{it} = \beta_y \Delta Y_{it} + \beta_{dti} DTI_{i,t-1} + \beta_{ur} UR_{it} + \beta_A Age_{it} + \beta_{cd} CD_{it} + \varepsilon_{it} \tag{5.1}$$

4.1.2 Models with change in debt

In this part, we replace debt burden variable with change in debt. Change in debt is calculated by using log difference of total debt of household and also ex ante value. By using equation (6), I also apply alternative regressions of equation (6) as in the models with DTI. The first alternative regression of equation (6) is done with different samples of households (boom/non-boom regions), as described previously. Secondly, I regress equation (6) with only the top quintile of households ranked by change in debt value, thereby showing the extent to which consumption would be affected by high debt burden. Lastly, regression excluding the wealth variable (as shown in equation 6.1) examines the pure effect of change in debt on change in consumption.

$$\Delta C_{it} = \alpha + \beta_w \Delta W_{it} + \beta_y \Delta Y_{it} + \beta_d \Delta Debt_{i,t-1} + \beta_{ur} UR_{it} + \beta_A Age_{it} + \beta_{cd} CD_{it} + \varepsilon_{it} \tag{6}$$

$$\Delta C_{it} = \beta_y \Delta Y_{it} + \beta_d \Delta Debt_{i,t-1} + \beta_{ur} UR_{it} + \beta_A Age_{it} + \beta_{cd} CD_{it} + \varepsilon_{it} \tag{6.1}$$

4.2 Robustness checks

4.2.1 Models with interaction terms

I investigate the robustness of the model predictions by using regressions with interaction terms, which are revised from Mian et al. (2013) and Baker (2015). For example, Baker (2015) only focuses on the effect of income on consumption. In that model, the debt variable only exists in the interaction term and does not independently influence the consumption variable. In the study by Mian et al. (2013), wealth is the main factor affecting changes in consumption. The change in housing value is especially key independent variable to explain the change in consumption in that paper. The leverage variable is also used both as an interaction term and an independent variable in the regression.

Based on those studies, I first consider the impact of wealth and debt burden on consumption. As in the baseline models, debt burden can be substituted by DTI or change in debt. Equations (7.1) to (7.3) replace debt burden with DTI. Interaction term between wealth and debt burden is included in the regression, which also uses debt burden as an independent variable. This is shown in equation (7.1), which is similar to the models in Baker (2015). Next, I estimate the impact of income and DTI on consumption with interaction term. Equation (7.2) is similar to the models in Mian et al. (2013) and also includes debt burden as an independent variable. Lastly, in equation (7.3), wealth, income, and DTI are independent variables to explain consumption changes. In this case, there are two interaction terms-one between wealth and debt burden, and the other between income and debt burden. Through equations (7.1) to (7.3), I focus on the coefficient of debt burden, and analyze whether there is a debt overhang effect on household consumption. Also, as in the baseline models, I calculate the changes in consumption, wealth, and income using inverse hyperbolic sine before differencing.

$$\Delta C_{it} = \alpha + \beta_w \Delta W_{it} + \beta_{int} \Delta W_{it} * DTI_{i,t-1} + \beta_d DTI_{i,t-1} + \varepsilon_{it} \tag{7.1}$$

$$\Delta C_{it} = \alpha + \beta_y \Delta Y_{it} + \beta_{int} \Delta Y_{it} * DTI_{i,t-1} + \beta_d DTI_{i,t-1} + \varepsilon_{it} \tag{7.2}$$

$$\Delta C_{it} = \alpha + \beta_w \Delta W_{it} + \beta_y \Delta Y_{it} + \beta_{int_1} \Delta W_{it} * DTI_{i,t-1} + \beta_{int_2} \Delta Y_{it} * DTI_{i,t-1} + \beta_d DTI_{i,t-1} + \varepsilon_{it} \tag{7.3}$$

The logic of regressions (8.1) to (8.3) is the same as for equations (7), except using change in debt as debt burden in the regressions with interaction terms. In equation (8.1), I consider wealth and change in debt as explanatory variables for change in consumption. The interaction term in this regression is between wealth and change in debt. Equation (8.2) includes income and change in debt as independent variables, and has interaction term between income and change in debt. Finally, in equation (8.3), wealth, income, and change in debt are all independent variables. Similarly to equation (7.3), this regression has two interaction terms.

$$\Delta C_{it} = \alpha + \beta_w \Delta W_{it} + \beta_{int} \Delta W_{it} * \Delta Debt_{i,t-1} + \beta_d \Delta Debt_{i,t-1} + \varepsilon_{it} \tag{8.1}$$

$$\Delta C_{it} = \alpha + \beta_y \Delta Y_{it} + \beta_{int} \Delta Y_{it} * \Delta Debt_{i,t-1} + \beta_d \Delta Debt_{i,t-1} + \varepsilon_{it} \tag{8.2}$$

$$\Delta C_{it} = \alpha + \beta_w \Delta W_{it} + \beta_y \Delta Y_{it} + \beta_{int_1} \Delta W_{it} * \Delta Debt_{i,t-1} + \beta_{int_2} \Delta Y_{it} * \Delta Debt_{i,t-1} + \beta_d \Delta Debt_{i,t-1} + \varepsilon_{it} \tag{8.3}$$

4.2.2 Models with log variables

To check the robustness, I replace the change variables with log variables. Thus, the changes in consumption, wealth, income, and debt burden variables are replaced by log consumption, log wealth, log income, and log debt burden. Equation (9.1) only estimates the effect of wealth and income on consumption with log terms. Equation (9.2) includes a debt burden variable in addition to wealth and income variables in the regression, and uses DTI as a debt burden variable. In equation (9.3), control variables are added to the previous equation: age of household head, and the dummy variable for head of household college degree.

$$logC_{it} = \alpha + \beta_w logW_{it} + \beta_y logY_{it} + \varepsilon_{it} \tag{9.1}$$

$$logC_{it} = \alpha + \beta_w logW_{it} + \beta_y logY_{it} + \beta_{dti} logDTI_{i,t-1} + \varepsilon_{it} \tag{9.2}$$

$$logC_{it} = \alpha + \beta_w logW_{it} + \beta_y logY_{it} + \beta_{dti} logDTI_{i,t-1} + \beta_A Age_{it} + \beta_{cd} CD_{it} + \varepsilon_{it} \tag{9.3}$$

5 Results

Since the models use DTI and change in debt as debt burden, I first examine the regression results of change in consumption with DTI. Next, I compare the estimates from other regression models (those with change in debt, with interaction terms, and with log variables) to check the robustness of the results. The first table of each subsection shows the results of regressions conducted over the entire period (20072015), and the second one presents the results done for each year. The results show that debt burden would negatively affect changes in consumption, and that this negative effect is greater immediately after the financial crisis.

5.1 Result of regression with debt-to-income ratio (DTI)

Table 1 shows the coefficients of debt-to-income ratio derived from the regressions. Column 1 represents the estimated results from equation (1), and Column 2 shows estimates from equation (2) using DTI as debt burden variable. Column 3 and 4 include additional control variables (Z) shown in equation (3) and (4), such as the change in unemployment rate, the age of the household head, whether the head of household holds a college degree, and the level of household income.

The results in columns 5 to 9 are from the baseline and alternative equations, so I focus on these five columns. The estimated coefficient in column 5 is from the baseline equation (5). The coefficients of wealth and income are positive, as expected, and statistically significant at the 0.1 percent level. The coefficient of debt to income is negative but non-significant. Column 6 and 7 show estimates using equation (5), for boom/non-boom regions respectively. The estimates of wealth and income are significant and positive. In non-boom regions, change in DTI is negative and statistically significant. The coefficient is -1.9 and larger in absolute value than that of boom regions. Column 8 shows the results from equation (5) using only samples in the top quintile of households ranked by DTI. The estimated coefficient of high DTI is -1.19 and statistically significant. Lastly, column

9 shows results from equation (5.1), which estimates the direct effect of DTI by omitting wealth variable in the regression.

As seen in Table 1, the coefficients of debt burden (DTI in this case) are not distinct. Thus, I regress the equations by the year to further examine the effect of debt burden on household consumption. I gathered all the estimated DTI coefficients by year, as shown in Table 2, and analyzed the results from the regressions.

Table 2 represents the results of regressions by year using DTI as debt burden. The rows of table show the coefficients of DTI of each given year. The first row shows that DTI has a non-significant effect on consumption over the whole period (20072015). Subsequently, the impact of debt burden on household consumption is analyzed for each year.

The first column of Table 2 shows the regression results from equation (2). This column describes the coefficients of DTI by each period when regressing change in consumption on change in wealth, income, and DTI. The second column shows coefficients of DTI by each period from equation (3), which includes wealth, income, debt burden, and unemployment rate. The third column displays the DTI coefficients related to equation (4); these are calculated from regression with wealth, income, debt burden, and other control variables, such as the age and education level of the household head.

I focus more on the coefficients of DTI from columns 4 to 8, since they are derived from the baseline model and its alternative regressions in which we are interested. Column 4 shows the coefficients of DTI (debt burden) in the baseline model. For the year 20082009, the point estimate -2.73 suggests that the effect of DTI on the change in consumption can matter. If one interprets the difference in the inverse hyperbolic sine (multiplied by 100) as the percent change, the estimate implies that an increase in a household's debt-to-income ratio from 1.0 to 1.1 would have reduced its consumption growth by 0.27 percentage points. This is statistically significant and significantly larger in absolute value than the coefficients for 2006-2007 and 2007-2008. Also, the coefficient of DTI affecting the change in consumption between 2009 and 2010 is -2.33 and statistically significant at the 0.1 percent

Table 1: Regression with debt-to-income ratio (DTI) (total 2007-2015)

	1 W, Y	2 W,Y, D	3 W,Y, D, UR	4 W,Y,D,Z	5 Baseline	6 Boom region	7 Non-boom region	8 High DTI	9 w/o wealth
Change in w	0.0337*** (0.001)	0.0377*** (0.001)	0.0374*** (0.001)	0.0374*** (0.001)	0.0374*** (0.001)	0.0432*** (0.002)	0.0323*** (0.002)	0.0373*** (0.001)	
Change in y	0.230*** (0.002)	0.208*** (0.003)	0.205*** (0.003)	0.206*** (0.003)	0.205*** (0.003)	0.177*** (0.004)	0.251*** (0.005)	0.206*** (0.003)	0.214*** (0.003)
Change in dti		-0.0071 (0.010)	-0.00706 (0.010)	-0.00643 (0.010)	-0.00629 (0.010)	0.00169 (0.010)	-1.900*** (0.249)		-0.00875 (0.011)
High dti								-1.191* (0.492)	
Change in unemployment rate			-1.780*** (0.257)	-1.809*** (0.257)	-1.818*** (0.257)	-2.172*** (0.339)	-1.345*** (0.391)	-1.824*** (0.257)	-2.048*** (0.259)
Income				-7.6E-05 (0.000)					
Age of HH head				-0.134*** (0.017)	-0.135*** (0.017)	-0.0981*** (0.022)	-0.176*** (0.026)	-0.131*** (0.017)	-0.135*** (0.017)
College degree				-0.125 (0.408)	-0.262 (0.398)	0.576 (0.498)	-1.432* (0.652)	-0.238 (0.399)	-0.253 (0.402)
_cons	1.391*** (0.119)	1.290*** (0.180)	0.940*** (0.186)	8.083*** (0.943)	7.773*** (0.921)	5.657*** (1.190)	10.47*** (1.439)	7.770*** (0.921)	7.780*** (0.928)
N	106302	41382	41382	41382	41382	22798	18584	41382	41524
adj. R-sq	0.135	0.119	0.12	0.122	0.122	0.108	0.144	0.122	0.108

Standard errors in parentheses
* p<0.05, **p<0.01, *** p<0.001

Table 2: Regression with debt-to-income ratio (DTI) - by year (2007-2015)

	1	2	3	4	5	6	7	8
Coefficients of DTI	W,Y,D	W,Y,D,UR	W,Y, D, Z	Baseline	Boom region	Non-boom region	High DTI	w/o wealth
2007-2015	-0.0071	-0.00706	-0.00643	-0.00629	0.00169	-1.900***	-1.191*	-0.00875
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.249)	(0.492)	(0.011)
2006-2007	-0.231	-0.221	-0.194	-0.19	-1.533*	0.0985	0.163	-0.199
	(0.220)	(0.219)	(0.219)	(0.219)	(0.607)	(0.212)	(1.449)	(0.222)
2007-2008	-0.789	-0.804	-0.792	-0.853	-4.106**	-0.147	1.423	-0.865
	(0.504)	(0.503)	(0.503)	(0.503)	(1.324)	(0.534)	(1.147)	(0.507)
2008-2009	-2.387***	-2.582***	-2.591***	-2.735***	-1.766***	-12.08**	-2.22	-2.698***
	(0.459)	(0.455)	(0.453)	(0.454)	(0.433)	(3.818)	(1.745)	(0.457)
2009-2010	-2.550***	-2.480***	-2.471***	-2.334***	-3.678***	-2.112***	-2.85	-2.621***
	(0.449)	(0.445)	(0.445)	(0.447)	(0.898)	(0.520)	(1.652)	(0.448)
2010-2011	-0.24	-0.231	-0.0702	-0.229	-0.473	0.559	4.826*	-0.0179
	(0.913)	(0.912)	(0.911)	(0.913)	(1.296)	(1.284)	(2.047)	(0.912)
2011-2012	-0.518***	-0.507***	-0.493***	-0.503***	-0.419***	-3.045**	-1.433	-0.521***
	(0.090)	(0.090)	(0.089)	(0.090)	(0.082)	(1.095)	(1.430)	(0.090)
2012-2013	-2.180***	-2.170***	-2.105***	-2.090***	-1.944***	-4.155*	-0.781	-2.223***
	(0.503)	(0.503)	(0.503)	(0.504)	(0.517)	(1.731)	(1.230)	(0.504)
2013-2014	-2.331***	-2.320***	-2.317***	-2.301***	-6.515*	-1.930***	-3.244*	-2.421***
	(0.466)	(0.466)	(0.466)	(0.468)	(3.125)	(0.437)	(1.283)	(0.470)
2014-2015	-0.789	-0.804	-0.792	-0.853	-4.106**	-0.147	1.423	-0.865
	(0.504)	(0.503)	(0.503)	(0.503)	(1.324)	(0.534)	(1.147)	(0.507)

Standard errors in parentheses

* p<0.05, **p<0.01, *** p<0.001

level, which is similar to that of the previous year. This means that, for every additional 10 percent of a household's income going to debt service, one would expect that its 2009-2010 consumption growth to be 0.2 percentage points lower.

On the other hand, the coefficient is -0.19 in the year prior to the recession (2006-2007), which increased to -0.85 during the recession (2007-2008), and -0.23 for year 2010-2011. These coefficients are very low and non-significant. This shows that the impact of DTI or debt burden was larger immediately after the financial crisis. Thus, debt burden (DTI in this case) has much more pronounced negative effects on consumption growth immediately after the recession. In addition, the coefficients of DTI during 2012-2014 are approximately -2.1 and -2.3, and statistically significant at the 0.1 percent level.

Column 5 reports the DTI coefficients when regressing the change in consumption only with households located in the boom regions; likewise, column 6 shows those for non-boom regions. The coefficients show larger negative values during the years 20082010. In particular, the DTI coefficient for 2008-09 in non-boom regions is -12.1 and statistically significant at the 1 percent level. This estimate implies that for every additional 10 percent of income going to debt service, consumption would be 1.21 percentage points lower in 2008-2009.

There is no clear tendency for whether DTI affects consumption more in boom or non-boom regions. The coefficients of DTI in all regions are mostly negative after experiencing the financial crisis. For example, the point estimates are -4.1 for 2007-2008, -1.77 for 2008-2009, -6.52 for 2013-14, and -4.11 for 2014-15. Moreover, the estimates for non-boom regions are -2 in 2009-2010, -3.05 in 2011-2012, and -4.14 in 2012-2013. This means that DTI would have a negative effect on household consumption.

Column 7 presents the results for households with high debt-to-income ratio (those in the top quintile): -2.22 and -2.85 for 200809 and 200910 respectively (non-significant), whereas the -3.25 for 20132014 is significant at the 5 percent level.

Lastly, the column 8 describes the DTI coefficient when applying regression without the wealth variable, thereby representing the pure effect of DTI on change in consumption. The coefficients are very similar to those in the baseline models in that they are significantly negative immediately after the financial crisis. In addition, the estimated values in year 2012-2014 are -2.22 and -2.42, which are significant at the 0.1 percent level.

5.2 Result of regression with change in debt

Regressions in this part are fundamentally similar to the regressions in Table 1 and Table 2, except using change in debt as debt burden. Table 3 represents the estimated results of equation (6) and (6.1). As in the models with DTI, I focus mainly on columns 5 to 9 in Table 3, and columns 4 to 8 in Table 4, as these analyze the effects of changes in debt on changes in consumption.

As seen in Table 3, the basic framework is similar to Table 1, the only difference being the use of change in debt as debt burden. From columns 5 to 9, the coefficients of wealth and income are positive and statistically significant at the 0.1 percent level. The coefficients of change in debt are all negative.

In particular, for households with high change in debt, the estimated coefficient is -4.156, which is large in absolute value and statistically significant at 0.1 percent. This implies that higher household debt has a larger negative effect on household consumption over the whole period (20007-2015).

Table 4 shows the coefficients of change in debt of each year. Compared to the values before and after the financial crisis, the estimated coefficients for 2008-2009 are significantly more negative. The coefficient of the baseline model is -2.31, -1.27 for regression with households in boom regions, -3.13 for regression with households in non-boom regions, -2.8 for the sample with high change in debt, and -2.51 for regression without the wealth variable. This suggests that debt burden, expressed in terms of change in debt, has a greater negative effect on changes in consumption immediately after the recession.

Table 3: Regression with change in debt (total 2007-2015)

	1	2	3	4	5	6	7	8	9
	W, Y	W,Y, D	W,Y, D, UR	W,Y,D,Z	Baseline	Boom region	Non-boom region	High Debt	w/o wealth
Change in w	0.0378***	0.0436***	0.0432***	0.0428***	0.0433***	0.0514***	0.0388***	0.0431***	
	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(0.007)	(0.005)	(0.004)	
Change in y	0.212***	0.202***	0.202***	0.216***	0.203***	0.202***	0.203***	0.203***	0.210***
	(0.005)	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)	(0.012)	(0.008)	(0.008)
Change in debt		-1.061*	-1.074*	-1.023*	-1.053*	-1.592*	-0.373		-1.165*
		(0.491)	(0.490)	(0.489)	(0.490)	(0.673)	(0.721)		(0.495)
High debt								-4.156***	
								(1.092)	
Change in unemployment rate			-5.669**	-5.646**	-5.745**	-4.846	-7.484*	-6.005**	-6.533**
			(2.109)	(2.103)	(2.108)	(2.851)	(3.151)	(2.108)	(2.118)
Income				-0.000489***					
				(0.000)					
Age of HH head				-0.103**	-0.0968**	-0.136**	-0.0448	-0.0969**	-0.0926**
				(0.034)	(0.034)	(0.046)	(0.052)	(0.034)	(0.035)
College degree				0.2	-0.647	-1.545	0.64	-0.619	-0.45
				(0.858)	(0.845)	(1.112)	(1.314)	(0.844)	(0.853)
_cons	1.760***	1.368***	0.841	8.986***	6.223**	8.733**	2.893	6.778***	6.091**
	(0.269)	(0.386)	(0.433)	(2.079)	(2.018)	(2.715)	(3.035)	(2.021)	(2.035)
N	13767	5339	5339	5339	5339	2965	2374	5339	5346
adj. R-sq	0.132	0.141	0.142	0.148	0.143	0.149	0.137	0.145	0.126

Standard errors in parentheses
* p<0.05, **p<0.01, *** p<0.001

Table 4: Regression with change in debt - by year (2007-2015)

	1	2	3	4	5	6	7	8
Coefficients of Change in Debt	W,Y,D	W,Y,D,UR	W,Y, D, Z	Baseline	Boom region	Non-boom region	High change in debt	w/o wealth
2007-2015	-0.918***	-0.914***	-0.930***	-0.935***	-0.815***	-1.065***	-1.374**	-1.098***
	(0.182)	(0.181)	(0.181)	(0.181)	(0.241)	(0.274)	(0.436)	(0.183)
2006-2007	-1.046*	-0.868	-0.943	-0.941	-0.43	-1.545*	-2.385*	-0.912
	(0.485)	(0.482)	(0.482)	(0.482)	(0.648)	(0.723)	(1.212)	(0.486)
2007-2008	-1.11	-1.134	-1.096	-1.118	-1.034	-1.218	-2.616	-1.232*
	(0.627)	(0.623)	(0.623)	(0.623)	(0.755)	(1.021)	(1.542)	(0.622)
2008-2009	-2.297***	-2.155**	-2.335***	-2.312***	-1.272	-3.127***	-2.798	-2.508***
	(0.684)	(0.679)	(0.677)	(0.678)	(0.940)	(0.949)	(1.663)	(0.680)
2009-2010	-0.545	-0.562	-0.606	-0.596	0.723	-1.895**	-0.174	-0.887
	(0.471)	(0.469)	(0.469)	(0.469)	(0.661)	(0.663)	(1.227)	(0.474)
2010-2011	-0.117	-0.106	-0.108	-0.102	-0.661	0.497	0.026	-0.151
	(0.484)	(0.484)	(0.484)	(0.484)	(0.653)	(0.722)	(1.172)	(0.485)
2011-2012	-1.428**	-1.406**	-1.373**	-1.405**	-1.497*	-1.333	-1.07	-1.733***
	(0.499)	(0.497)	(0.497)	(0.497)	(0.685)	(0.721)	(1.154)	(0.502)
2012-2013	0.0606	0.0456	0.093	0.0773	-0.99	1.455	0.279	-0.123
	(0.521)	(0.520)	(0.520)	(0.520)	(0.669)	(0.816)	(1.172)	(0.523)
2013-2014	-0.777	-0.776	-0.793	-0.789	-1.122	-0.0849	-0.914	-0.935
	(0.560)	(0.560)	(0.560)	(0.560)	(0.752)	(0.831)	(1.267)	(0.565)
2014-2015	-1.061*	-1.074*	-1.023*	-1.053*	-1.592*	-0.373	-4.156***	-1.165*
	(0.491)	(0.490)	(0.489)	(0.490)	(0.673)	(0.721)	(1.092)	(0.495)

Standard errors in parentheses

* p<0.05, **p<0.01, *** p<0.001

5.3 Result of regression with interaction terms

Table 5 shows the results of regressions with interaction terms, which are matched to equations (7.1) to (8.3). Columns 1 to 3 of Table 5 are derived from equations (8.1), (8.2), and (8.3) respectively, using change in debt as the debt burden variable. On the other hand, columns 4 to 6 present the results of equations (7.1), (7.2), and (7.3) respectively, using DTI as debt burden. More specifically, columns 1 and 4 are results from regressions with wealth, debt burden, and their interaction term; columns 2 and 5 show results from regression with income, debt burden, and their interaction term; columns 3 and 6 are from regression with wealth, income, debt burden, and their interaction terms.

Table 6 represents the annual estimates for regressions with interaction terms. Columns 1 to 3 use change in debt as debt burden, and columns 3 to 6 use DTI as debt burden. In columns 1 to 3, the coefficients of change in debt are larger in absolute value during the period between 2008 and 2009, compared to the previous and following years. Specifically, the estimated coefficients are -2.289 for the regression with wealth, change in debt, and interaction term between those variables; -2.471 for income, change in debt, and their interaction; and -2.263 for wealth, income, change in debt variables, and their interactions. These results show that the extent to which change in debt influences consumption is larger immediately after the financial crisis; and that household consumption is negatively correlated with debt burden.

However, columns 4 to 6 show that, in regressions with interaction terms using DTI as debt burden, the coefficients do not show an effect of debt burden on household consumption. However, the estimated results using both income and debt-to-income ratio during the period 2013-2014 are significantly large in absolute value. The point estimation of regression using only income, DTI, and their interaction terms is -9.1 and statistically significant at the 0.1 percent level; the addition of wealth to the previous regression give a coefficient of -8.62, which is significant at the 0.1 percent level. Since the difference in the inverse hyperbolic sine (multiplied by 100) can be interpreted as the percent change, these estimates imply that an increase in a household's debt-to-income ratio from

1.0 to 1.1 would have reduced its consumption growth by nearly 0.9 percentage points.

5.4 Result of regression with log varaiables

Table 7 presents the results of regressions with log variables. In this part, I replace debt burden with DTI. Equations (9.1) to (9.3) show the regression models used in this section. Log DTI is an independent variable that explains the log consumption. Column 2 of Table 7 shows the regression results with log variables of wealth, income, and DTI. Column 3 shows the results with additional control variables, such as age and the dummy variable for education level of the household head. The coefficients of log DTI are negative and statistically significant at the 0.1 percent level.

Table 8 shows the coefficients of log DTI for each year. The estimated coefficients in the first and second columns of Table 8 are matched to the second and third columns, respectively, of Table 7. The results show the negative relationship between debt burden and household consumption. When using log variables, there is no significant difference between pre-crisis and pose-crisis periods. However, the extent to which debt-to-income ratio affects household consumption is comparatively stable, with the coefficient of approximately -0.03.

Table 5: Regression with interaction terms (total 2007-2015)

	1	2	3	4	5	6
	Change in debt	Change in debt	Change in debt	DTI	DTI	DTI
Change in w	0.0654***		0.0383***	0.0624***		0.0369***
	(0.002)		(0.001)	(0.002)		(0.001)
interaction(w*debt)	0.00485*		0.00315*			
	(0.002)		(0.001)			
Change in debt	-0.975***	-1.056***	-0.899***			
	(0.270)	(0.183)	(0.182)			
Change in y		0.217***	0.209***		0.225***	0.215***
		(0.003)	(0.003)		(0.003)	(0.003)
interaction(y*debt)		-0.00487	-0.00465			
		(0.003)	(0.003)			
interaction(w*dti)				0.0008		-0.00033
				(0.000)		(0.000)
DTI				0.0668**	0.658***	0.633***
				(0.024)	(0.087)	(0.089)
interaction(y*dti)					-0.00224***	-0.00220***
					(0.000)	(0.000)
_cons	0.975***	1.392***	1.380***	0.902***	1.689***	1.614***
	(0.253)	(0.171)	(0.170)	(0.244)	(0.171)	(0.169)
N	46116	45925	45730	46426	46404	46201
adj. R-sq	0.024	0.112	0.127	0.023	0.113	0.127

Standard errors in parentheses
* p<0.05, **p<0.01, *** p<0.001

Table 6: Regression with interaction terms - by year (2007-2015)

	Change in Debt W, D	Change in Debt Y, D	Change in Debt W, Y, D	DTI W, D	DTI Y, D	DTI W, Y, D
2007-2015	-0.975***	-1.056***	-0.899***	0.0668**	0.658***	0.633***
	(0.270)	(0.183)	(0.182)	(0.024)	(0.087)	(0.089)
2006-2007	-1.293*	-1.223*	-1.204*	1.555**	-0.256	-0.156
	(0.554)	(0.494)	(0.491)	(0.545)	(0.198)	(0.517)
2007-2008	-1.091	-1.202	-1.163	0.998***	-1.316	-1.631
	(0.701)	(0.630)	(0.632)	(0.301)	(1.795)	(1.815)
2008-2009	-2.289**	-2.471***	-2.263***	-0.0439	0.205	-1.677
	(0.820)	(0.688)	(0.684)	(0.737)	(0.711)	(1.012)
2009-2010	-1.394*	-0.86	-0.561	0.25	-0.982	-0.955
	(0.542)	(0.484)	(0.479)	(0.340)	(0.900)	(0.892)
2010-2011	-0.0766	-0.163	-0.119	2.031*	0.269	0.676
	(0.658)	(0.485)	(0.484)	(0.954)	(0.633)	(0.836)
2011-2012	-1.547**	-1.350**	-1.110*	0.0144	0.692**	-0.159
	(0.554)	(0.506)	(0.502)	(0.079)	(0.248)	(0.607)
2012-2013	-0.25	-0.125	0.0823	0.298	-2.346***	-2.602
	(0.728)	(0.522)	(0.520)	(1.458)	(0.505)	(1.730)
2013-2014	-0.0746	-0.746	-0.628	-0.0643	-9.099***	-8.619***
	(1.122)	(0.567)	(0.562)	(1.006)	(2.044)	(2.030)
2014-2015	-0.927	-1.218*	-1.188*	1.259	1.977**	1.372
	(1.473)	(0.496)	(0.492)	(1.424)	(0.655)	(0.703)

Standard errors in parentheses

* p<0.05, **p<0.01, *** p<0.001

Table 7: Regression with log Variables (total 2007-2015)

	1	2	3
	Log C	Log C	Log C
Log Y	0.650***	0.568***	0.534***
	(0.002)	(0.003)	(0.003)
Log W	0.0713***	0.0780***	0.0860***
	(0.001)	(0.001)	(0.001)
Log DTI		-0.0317***	-0.0293***
		(0.002)	(0.002)
Age of HH head			-0.00705***
			(0.000)
College degree			0.0491***
			(0.004)
_cons	2.012***	2.586***	3.136***
	(0.012)	(0.020)	(0.022)
N	116429	45530	45530
adj. R-sq	0.696	0.624	0.647

Standard errors in parentheses
* p<0.05, **p<0.01, *** p<0.001

Table 8: Regression with log variables - by year (2007-2015)

	1	2
	W,Y, DTI	W,Y, DTI, Z
2007-2015	-0.0317***	-0.0293***
	(0.002)	(0.002)
2006-2007	-0.0353***	-0.0337***
	(0.005)	(0.005)
2007-2008	-0.0264***	-0.0253***
	(0.005)	(0.005)
2008-2009	-0.0295***	-0.0271***
	(0.005)	(0.005)
2009-2010	-0.0221***	-0.0199***
	(0.004)	(0.004)
2010-2011	-0.0309***	-0.0250***
	(0.005)	(0.005)
2011-2012	-0.0233***	-0.0197***
	(0.00451) (	(0.004)
2012-2013	-0.0471***	-0.0453***
	(0.005)	(0.004)
2013-2014	-0.0332***	-0.0319***
	(0.005)	(0.005)
2014-2015	-0.0350***	-0.0311***
	(0.004)	(0.004)

Standard errors in parentheses

* p<0.05, **p<0.01, *** p<0.001

6 Conclusion

This study examines whether debt burden affects household consumptions. If so, the extent of this influence becomes an important issue because total debt has increased significantly for the past few decades in Korea. The question starts from the point at which debt overhang might hold back household consumption.

Traditionally, debt was not considered as a key element that can affect consumption. Until recently, studies analyzing factors for changes in consumption did not include debt as an independent variable in the regression. In conventional models, change in consumption instead decides the value of the debt variable. However, the present study considers debt as an independent variable that can affect household consumption. Consequently, it examines whether the magnitude of debt has different influence before and after the financial crisis of 2008. The extent to which debt affects consumption is examined via regression analysis, where the debt variable is replaced with debt-to-income ratio (DTI) or change in debt. The study utilizes data from the Korea Labor and Income Panel Study (KLIPS) to examine pre-and post-crisis differences during the period 20072015.

The first regressions employ DTI ratio as the debt burden variable, whereas the second series of models use change in debt as debt burden. To check the robustness of the models, the effect of debt burden is further examined by applying regressions with interaction terms of debt burden. Lastly, regressions with log variables rather than change in values were applied.

The regression results show a negative relationship between debt burden and household consumption. This implies that increased household debt would inhibit the growth of household consumption. Moreover, the coefficient of debt burden is higher in absolute value immediately after the financial crisis. Thus, the effect of debt burden on household consumption was greater when the economy went through the economic crisis.

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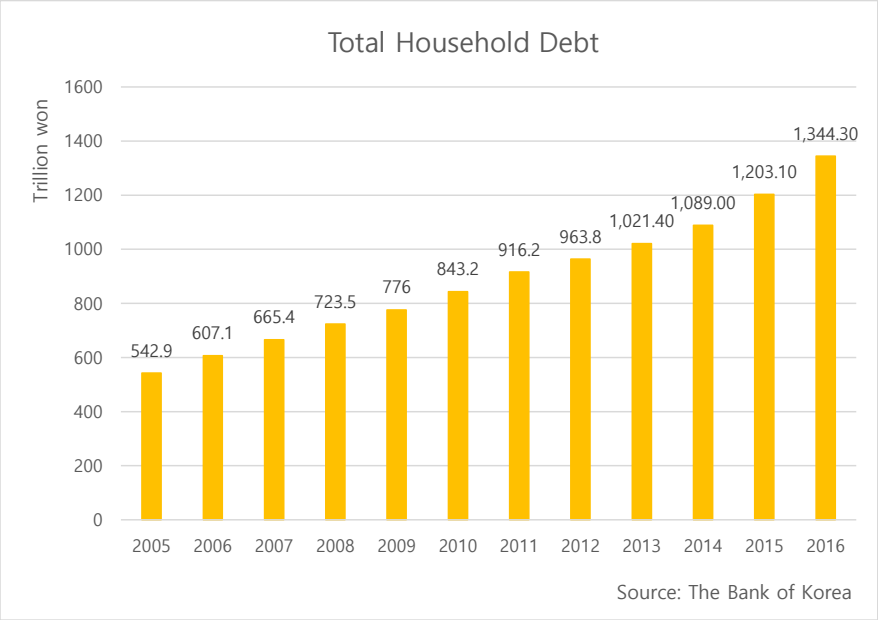


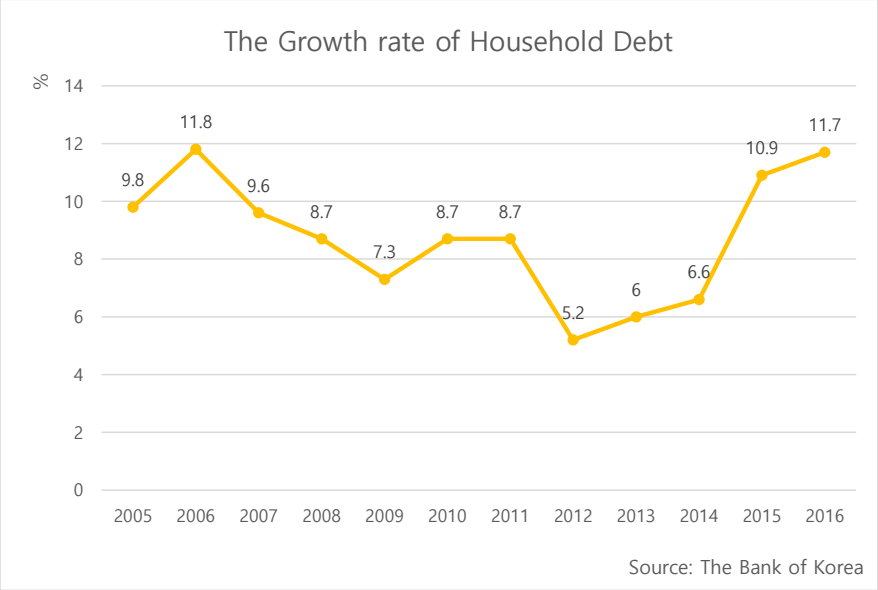


Figure 1: Household debt in Korea

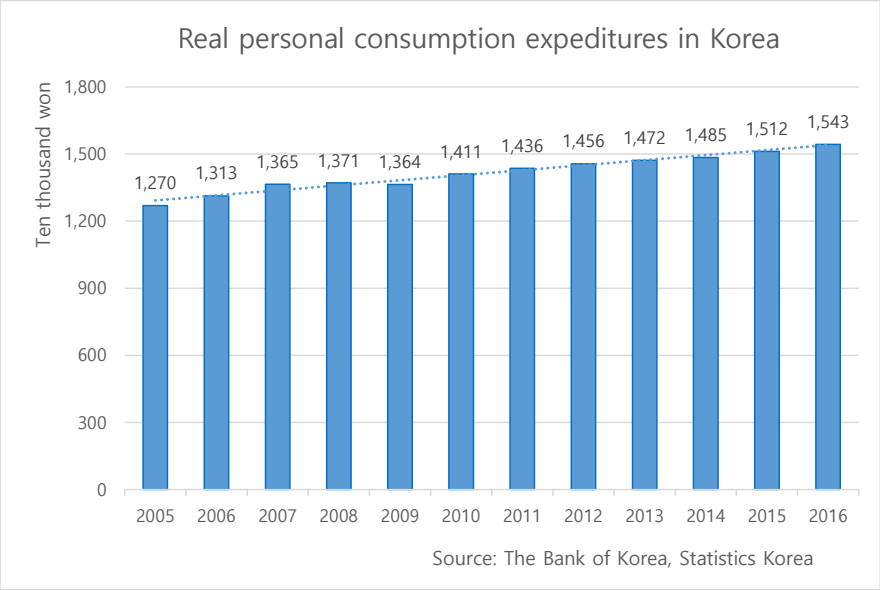
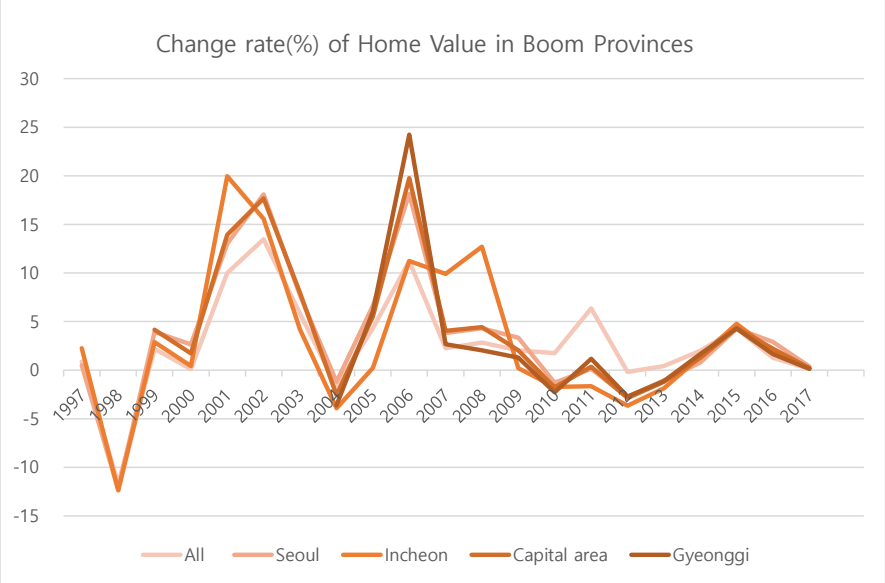


Figure 2: Personal consumption expeditures in Korea



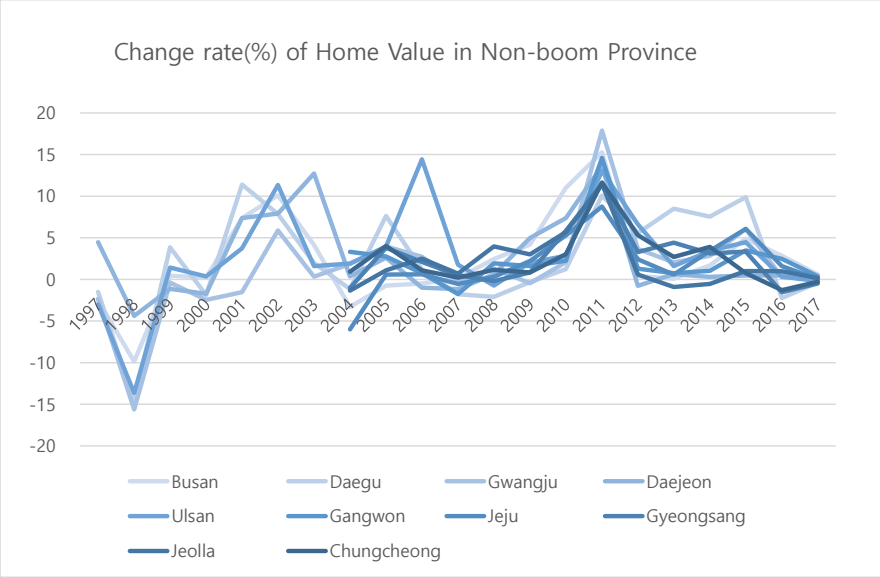


Figure 3: Boom and non-boom regions of Korea

국문초록

부채 부담이 가계 소비에 미치는 영향

이 논문은 가계의 부채부담이 가구 소비에 미치는 영향에 대하여 여러 회귀모형을 이용하여 분석하고 있다. 전통적으로 소비에 대한 영향을 분석할 때 부채 변수를 고려하지 않은 것과 달리, 이 논문의 모형들은 부채 부담을 설명변수로 사용하여 가계 소비에 얼마나 부채가 영향을 미치는지를 보고자했다. 부채 부담의 변수로는 가계의 총부채상환비율(DTI)과 총부채 금액변화를 각각 사용하였다. 회귀분석 결과 가계 부채와 소비는 음의 상관관계를 나타내며, 이는 부채 부담이 늘어날수록 가구들의 소비를 저하시키는 역할을 하는 것을 보여준다. 더욱이 이러한 부채의 소비 저하 효과는 금융위기 직후에 더 크게 나타나는 것으로 보인다.

주요어 : 가계 소비, 부채부담, DTI, 금융위기

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